ENVIRONMENTAL STRATEGIES CORPORATION

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RISK MANAGEMENT PLAN FOR OFFSITE AREAS DUTCH BOY SITE CHICAGO, ILLINOIS

PREPARED

FOR

NL INDUSTRIES, INC.

PREPARED

BY

ENVIRONMENTAL STRATEGIES CORPORATION

MARCH 16, 2000

San Jose, CA ▪ Boxborough, MA ▪ Pittsburgh, PA ▪ Minneapolis, MN ▪ Houston, TX ▪ Cazenovia, NY ▪ Burbank, CA ▪ Durham, NC ▪ Tulsa, OK ▪ Somerset, NJ

Contents

Introduction

Background

NL Industries, Inc. (NL), retained Environmental Strategies Corporation (ESC) to prepare this Risk Management Plan (RMP) to address the mitigation of risks to human health and the environment in the offsite residential areas surrounding the Dutch Boy Site (Site), in Chicago, Illinois. This plan has been prepared in accordance with the March 26, 1996, Unilateral Administrative Order (Order) issued to NL by the U.S. Environmental Protection Agency (EPA).

Pursuant to the requirements of the Order, ENVIRON International Corporation (ENVIRON) prepared the *Final Revised Sampling and Analysis Plan, Dutch Boy Site, Chicago, Illinois,* (SAP) dated December 11, 1996, to guide the investigation of lead in Site soil. Based on the results of this investigation, ENVIRON prepared the *Extent of Contamination Summary, Dutch Boy Site, Chicago, Illinois,* (EOC) dated November 19, 1997. The EPA authorized an additional residential sample collection program in a letter dated March 26, 1999. ESC collected additional residential soil samples on September 11 and November 13, 1999. ESC prepared a summary report, "Residential Soil Sample Lead Analysis Report" for the Dutch Boy site, Chicago, Illinois, dated January 2000. Residential lead levels are summarized in Section III of this plan.

The RMP evaluates remedial strategies for managing and mitigating the potential threat to human health and the environment posed by the residential soil lead levels.

Site Description and History

The Dutch Boy Site is located at 12042 South Peoria Street, Cook County, Chicago, Illinois (Figure 1). Residential areas surrounding the site predominantly consist of single family residences situated on lots that are approximately 50 feet by 150 feet in size. Industrial facilities and warehouses immediately surround the Dutch Boy Facility to the north and south, and vacant or abandoned lots are present to the east and west. Railroad tracks reportedly associated with former operations at the Dutch Boy Site are present immediately south of the facility.

Historic land use at the Dutch Boy Site has included the manufacture and refinement of white lead (lead carbonate) and lead oxide for lead-based paints and other lead-related products from 1906 until approximately 1980. According to Sanborn maps and historical aerial photographs, extensive building demolition occurred at the Site in the mid-1980s, with the final demolition of the Mill Building in 1996. Some structures were razed as early as the turn of the century.

Various other industrial activities have been conducted in the immediate vicinity of the Dutch Boy Site, including an aluminum foundry, metal machining shops, vehicle and heavy equipment maintenance and storage, junkyards, coal yards, and other metal treatment, forging, finishing, and pickling operations. Sanborn maps, included in the SAP, show the specific locations of these operations. Although most of the industrial properties surrounding the Site are currently abandoned or vacant, it is likely that historical activities at these facilities have influenced lead concentrations in offsite residential area soils.

Extent of Contamination

The Extent of Contamination (EOC) survey for the Dutch Boy Site was prepared in accordance with the March 26, 1996, Unilateral Administrative Order issued by the U.S. EPA to NL Industries, Inc. The primary objective of the EOC survey was to evaluate the vertical and horizontal extent of lead in soil at the Site and in surrounding areas. The EOC survey was based on the *Final Revised Sampling and Analysis Plan, Dutch Boy Site, Chicago, Illinois* (ENVIRON December, 1996) (the SAP). In total, more than 350 environmental samples from 151 locations at the Site and its vicinity were collected and analyzed. The EOC report summarizes the results of this sampling and delineates the extent of constituents likely attributable to historic activities at the Dutch Boy Site.

ESC performed additional offsite soil sampling on September 11, 1999, and November 13, 1999. Representative shallow soil samples were collected from 17 locations within the residential areas surrounding the Site. Results for the sampling program were provided to the EPA in the *Residential Soil Sample Lead Analysis Report* (ESC, 2000). The EPA approved the report, which constitutes the final portion of the EOC survey for the site, on January 21, 2000.

The extent of potentially impacted offsite residential soils containing lead at concentrations greater than 500 mg/kg is generally limited to the properties just north-northeast, and to a lesser degree, south of the Site. Figure 2 shows the extent of offsite lead concentrations in soil exceeding 500 mg/kg. Potentially impacted residential areas are shaded gray. Lead concentrations in shallow soil this area range from 500-16,200 mg/kg, with concentrations generally averaging between 500 and 2,000 mg/kg.

Residential areas to the south of the site were built on former industrial properties. It is possible that the lead concentrations found in soil samples collected south of the site resulted from prior industrial activities, and are not related to the Dutch Boy site. The prevailing wind direction to the north-northeast further indicates that the Dutch Boy site is unlikely to have been the source of the lead observed at these locations (Figure 2). The remainder of the RMP addresses site remediation considerations and recommends remedial alternatives for the residential areas to the north and north-east of the site.

Site Remediation Considerations

For the purpose of the RMP, the extent of contamination has been compared to a residential lead value of 500 mg/kg for lead in soil based on present and future residential use of the residential area surrounding the Site. Accordingly, this RMP focuses on shallow residential soils that exceed 500 mg/kg and evaluates remedial alternatives that minimize potential exposure to this material.

Volume of Contaminated Soil

The volume of contaminated soil is estimated based on the number of residences affected by lead levels in soil above 500 mg/kg, based on the spatial distribution of soil sample locations in which lead was detected above 500 mg/kg. The number of affected residential properties north and northeast of the site was estimated to be 150. The estimated area requiring remediation was based on an average lot size of 50 feet by 125 feet, and the assumption that the house footprint occupies 45% of the lot. Excavating the top six-inches of soil at each property results in an estimated volume of 64 cubic yards of excavated soil per property, or a total of 9,600 cubic yards of excavated soil.

Principal Threat Wastes

The EPA has established general expectations, as detailed in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), for dealing with the threat posed by hazardous substances at a Site. The Preamble to the NCP sets out a program expectation regarding the treatment of principal threats whenever practicable, and defines a principal threat "....as wastes that cannot be reliably controlled in place, such as liquids, highly mobile materials (e.g., solvents), and high concentrations of toxic compounds (e.g., several orders of magnitude above levels that allow for unrestricted use and unlimited exposure)." EPA has expressed a preference for treatment, wherever practicable, to address principal threat wastes.

Based on the levels of lead in soil on the residential properties surrounding the Site, it is anticipated that approximately 9,600 cubic yards of soil may be characterized as principal threat wastes. EPA requires that treatment of principal threat wastes be considered, but does not necessarily require that treatment be conducted, depending on site-specific considerations.

Remedial Strategies

The fundamental goal of any remedial strategy for the residential areas surrounding the Dutch Boy Site is to mitigate the risk to human health and the environment presented by lead-contaminated soil. Risk from residential soils with concentrations of lead can be mitigated by interrupting the pathway between the source of the risk (the soil) and residents, or by removing the source of the risk altogether. Pathways can be interrupted by physically or chemically immobilizing the lead in the soil matrix or by introducing a physical barrier to the soils, such as a cap or cover. Source removal in this area of the Site would require excavation of the contaminated soil and disposal in an appropriate facility. Given the lead concentrations in soil, some form of treatment may be required prior to offsite disposal. This would be determined by a formal TCLP profile of the soil.

Consistent with EPA's guidance on principal threat and low-level threat wastes, excavating the principal threat wastes is the remedial strategy that is most applicable, given conditions on the residential properties surrounding the Dutch Boy Site.

Technology Screening

The risk from exposure to lead in soil can be mitigated by a combination of containment and treatment of lead-containing soil, or significantly reduced via excavation and disposal of lead-containing soils. Containment remedies rely on reducing access to lead in soil to mitigate exposure. Treatment focuses on reducing the mobility of lead in the environment and/or reducing the volume of the contaminated media. Treatment technologies for lead focus on the chemical or physical immobilization of lead within the soil matrix or the separation of lead from the soil matrix. These general categories of treatment technologies are discussed below. The purpose of this chapter is to identify technologies that will be used to develop remedial alternatives in the subsequent chapter. Technologies that are determined to be inappropriate for use on the residential areas surrounding the Dutch Boy Site are not evaluated further.

Technologies will be screened in accordance with the Administrative Order for the Site (EPA 1996b), which states in section V.3.d "develop and submit a Risk Management Plan to reduce the risks associated with the lead-contaminated soils... The plan should consider various alternatives to reduce the risks, compare cost and protectiveness of each alternative, and recommend an alternative to be implemented that is cost-effective and protective of human health and the environment."

Containment Technologies

The objective of a containment strategy for the residential areas surrounding the Dutch Boy Site would be to break the direct contact pathway between contaminated soil and potential receptors. In order for a cap or cover system to be effective, it should be continuous over the entire affected area. Placing a series of caps or covers over noncontiguous areas of contamination along a series of residential yards would reduce the overall effectiveness of the system and generate significant maintenance and feasibility problems. A Site-wide soil cover would provide adequate containment and would prevent direct exposure to the lead-impacted soils; however, this is not practical for residential yards.

Installation of an effective cover system also requires preparation of the existing Site surface. Cover stability on the residential areas surrounding the Site would require ensuring proper drainage to prevent cover erosion and degradation. Cover systems also require periodic monitoring and maintenance to ensure the protectiveness and durability of the remedy. Implementing these requirements in a residential area would not be feasible or practical.

A concrete or asphalt cap would not be a reasonable containment option because it would not adequately replace a residential yard. Therefore, a cover constituting several feet of soil would be the only viable cover technology. However, this would impact the grade of the property and the house, and is not practical for a series of residential yards. Therefore, a containment technology is not selected for further evaluation.

Immobilization Technologies

Immobilization technologies are the most commonly used form of treatment prior to disposal. The most common method of immobilization is stabilization/solidification (S/S), which physically binds the soil matrix together more firmly. This can be done *ex-situ* or *in-situ* and is accomplished by mixing the lead-contaminated soil with a binding reagent to hold together more firmly the soil matrix and the lead compounds or particles. The S/S technique has been used widely at many lead-contaminated Sites, with a variety of binding agents and is a preferred technology for treatment prior to offsite disposal. With *ex-situ* S/S, soil is excavated and mixed with the reagent in a pug mill, then replaced in the subsurface or disposed in a secure chemical landfill. *In-situ* S/S relies on injecting the binding agent directly into the subsurface using jets, augers, backhoes, draglines, or other soil mixing equipment. The primary challenge with *in-situ* S/S is achieving an acceptable degree of mixing between the contaminated soil and reagent in the subsurface and verifying the stability of the resultant mixture. *Ex-situ* S/S produces much better mixing and long term stability.

Surface and subsurface access to the residential yards surrounding the Site is heavily obstructed and limited. The large-scale tilling or *in-situ* mixing equipment is not likely to effectively reach the subsurface of the residential area. Furthermore, the space needed for the mobility and set-up of this equipment (jets, augers, backhoes, draglines, or other soil mixing equipment) is very limited in this residential area. In addition, *in-situ* S/S has many more uncertainties with respect to the complete mixing and immobilization of contaminants. Consequently, *ex-situ* S/S is preferred over *in-situ* S/S as an immobilization technology for this Site.

The addition of binding agents to the soil, whether treated *ex-situ* or *in-situ,* will result in a larger volume of material than that which was excavated initially. Volume expansion can range from 10% to 50% depending on the reagent used for stabilization. This must be accounted for during cost estimating. Using vendor quotes, ESC determined that onsite treatment is approximately $37.75 per ton of soil treated and reagent costs approximately $425 per ton, based.

Another method for immobilizing lead on soil is vitrification. As with S/S, this can be done *ex-situ* or *in-situ*. Vitrification uses energy (electrical or heat) to melt and convert the soil matrix and contaminants to a glass-like solid substance. Once converted to a glass-like solid, the soil and contaminants are typically very stable and exhibit very low levels of contaminant leaching. The stability of the vitrified soil depends on the chemistry of the soil; additional compounds may be required to ensure the desired stability after the melting process. Another advantage of vitrification is that any organic compounds present in the contaminated soil would be destroyed through pyrolysis. Vitrification, though, is a very energy-intensive and therefore expensive process. Because of this, vitrification has been used primarily for solidifying radioactive wastes. Typical vitrification costs range from $400 to $870 per cubic yard and higher (EPA 1994a, 1994b, 1997). In addition, the equipment and process will pose large public hazards in a residential area. Remnants of the end product, the glass-like solid substance, could also pose a public hazard.

Both S/S and vitrification can convert soil and lead contamination to a highly immobile, stable form. Vitrification produces a more stable end product than S/S, but is considerably more expensive and potentially poses public safety hazards. Since lead is generally nonreactive and insoluble, the incremental increase in effectiveness at immobilizing lead offered by vitrification is not worth the additional costs. S/S is equally acceptable at immobilizing lead and is sufficiently protective of human health and the environment. However, the required equipment for *in-situ* S/S is not feasible in a residential area. Therefore, only the lower cost *ex-situ* S/S will be addressed in evaluating remedial scenarios.

Separation Technologies

Another general treatment strategy for lead-contaminated soil is the removal or separation of lead from the soil matrix, leaving clean soil. This can be done *in-situ* or *ex-situ*.

Ex-situ methods involve excavation of soil and washing the soil with water or reagents. Water washing generally physically separates the fine fraction of soils, which usually contains most of the lead. Two waste streams result: (1) a concentrated lead-contaminated aqueous liquid or slurry with a high percent solids, and (2) relatively clean soil. The clean soil may be placed back at the Site, but the water-based effluent from the washing process requires appropriate disposal. The unit cost for disposing of lead-contaminated liquids is often higher than disposal for the original contaminated soil, although, the smaller volume may offset this cost.

Chemical solvents can also be used to isolate and solubilize the lead with selective leaching; thus, removing it from the soil matrix. As a result, a liquid chemical waste enriched in lead that requires special disposal and clean soil becomes an issue. Soil washing/separation has been done at many Sites with lead-contaminated soil, including the Ewan Property, New Jersey; Zanesville Well Field, Ohio; and the Twin Cities Army Ammunition Plant, MN. Soil washing costs range from $60 to $245 per cubic yard. This does not include disposal of the contaminated effluent, which generally costs approximately $300 per 55-gallon drum (EPA 1994, 1994b, 1997). The amount of waste effluent generated will depend on the washing process, determined in pilot tests, and the reagents used. Because of the high costs of disposing liquid waste effluent, soil washing processes are not considered further.

In-situ methods use liquid-based flushing of the contaminant from the soil with capture of the contaminant-enriched flushing agent. Soil flushing of lead-contaminated soil has reportedly only been done once, at the Lipari Landfill, New Jersey. The Lipari flushing system required extraction wells below the zone of contamination. Because *in-situ* flushing has not been widely used for inorganics, it is not appropriate for the Dutch Boy Site.

Another *in-situ* flushing technology is electrokinetics. Electrokinetics provides *in-situ* selective removal of lead and other ionic compounds from saturated soils. Electrokinetics uses electrodes installed in the soil to induce an electrical field in the subsurface. A low pH acid front is generated in the pore water at the negatively charged electrode. This acid front migrates across the subsurface to the opposite, positively charged electrode. Metallic and other compounds are dissolved into the low pH water. Dissolved ions then migrate through the water, under the electric potential gradient to the electrode that carries the opposite charge of the ion. Lead is generally present in soils as positively charged (cationic) oxide compounds, so it would migrate to the negatively charged electrode. Once the lead has been flushed from the soil, the electric current is shut off, the subsurface conditions return to normal, and the metals precipitate out in a much smaller volume of contaminated soil, which can then be excavated. Refinements on this technology include use of electrodes installed into wells; the contaminants migrate into the wells and can be pumped out.

Since the migration of the contaminants occurs in the dissolved phase, electrokinetics is really only applicable in well-saturated soils. Dry soils may require additional water to be added to the system. Given the extensive residential activity and impermeable pavements and sidewalks at the residences, soil saturation would be difficult to achieve. Electrokinetics has been used on lead-contaminated soils, primarily in pilot-test scenarios. Although electrokinetics has been more widely used in Europe, it is not yet commonly used in the U.S. Because of the lack of use in the U.S. and the requirement for well-saturated soils, electrokinetics is not appropriate for use on the residential areas surrounding the Dutch Boy Site.

Excavation/Disposal

Excavation removes contaminants above the given cleanup level (currently assumed to be 500 mg/kg). Excavated areas are then backfilled. The excavated material is treated, as necessary, and is transported to an appropriate landfill for proper disposal.

Summary

Several proven technologies exist to mitigate and manage the risks posed by soil at the Dutch Boy Site, including containment, excavation/disposal, immobilization, and separation. Technologies such as soil washing, chemical extraction, electrokinetics, and vitrification are all technologically immature, generate large secondary waste streams, and are not cost effective. Therefore, the most feasible technologies for the residential areas surrounding the Dutch Boy Site are *ex-situ* stabilization/solidification, and excavation/disposal. These technologies are well proven, appropriate for Site conditions, and are protective of human health and the environment.

Description Of Remedial Scenarios

The remedial scenarios most well suited for the Dutch Boy Site include various combinations of excavation, treatment, disposal, and containment. Unit cost and technology performance data are taken from a variety of sources including vendor quotes, R. S. Means Co., 1999, *Environmental Remediation Cost Data-Unit Price;* EPA 1994a, *Remediation Technology Screening Matrix;* EPA 1994b, *Innovative Site Remediation Technology: Solidification/Stabilization, Volume* 4; and EPA 1997, *Engineering Bulletin. Technology Alternatives for the Remediation of Soils Contaminated with As, Cd, Cr, Hg, and Pb.*

Lead Affected Soils

Based on the technologies evaluated in the preceding chapter, two alternatives were considered that meet the objective of the Administrative Order of being adequately protective of human health and the environment. These alternatives are as follows:

- Removal and offsite disposal of soil with lead concentrations greater than 500 mg/kg, and
- Removal and offsite treatment/disposal of soil with lead concentrations greater than 500 mg/kg.

These are discussed in detail below.

Alternative 1 - Excavate All Unpaved Area Soils with Greater than 500 mg/kg Lead, Dispose Offsite, and Backfill to Original Grade

This alternative considers the excavation and disposal of the top 6-inches of soil within the unpaved residential areas that exceed 500 mg/kg. Excavated soil would be disposed offsite and be replaced with compacted clean fill to the original grade. Assuming an area of approximately 57,300 square yards and an average excavation depth of 6-inches, the cost for removal and disposal of the resulting 9,600 cubic yards of lead-impacted soil would be $2.2 M.

Alternative 2 - Excavate All Unpaved Area Soils with Greater than 500 mg/kg Lead, Treat/Dispose Offsite, and Backfill to Original Grade

This alternative considers the excavation, treatment, and disposal of the top 6-inches of soil within unpaved residential areas that exceed 500 mg/kg. Similar to Alternative 1, excavated soil would be treated and disposed offsite. Excavated soil would be replaced with compacted clean fill to the original grade. Using the same area and volume assumptions as Alternative 1, the maximum total volume for treatment with S/S, transportation, and secure landfill disposal is 9,600 cubic yards. Excavation, treatment and disposal costs are estimated to be $2.5 M.

Evaluation of Remedial Scenarios

Comparison of Alternatives

The preferred remedial alternative is one that protects human health and the environment over the long term. The evaluation of alternatives is weighted primarily on protectiveness and cost, in accordance with the Order. Both the alternatives that passed through the screening process are protective of human health and the environment.

Both alternatives remove the top 6-inches of soil with concentrations of lead above 500 mg/kg. This mitigates any potential future exposures and risks associated with the principal threat wastes. These alternatives are protective of human health because exposure to the lead present in the soil is interrupted. Soils containing lead are no longer exposed at the surface and 6-inches of clean soil is used to cover the base of the excavated area, minimizing any exposure to soils at depth. This strategy removes all long-term risk under a residential scenario and minimizes future operations and maintenance burdens.

Alternative 2 also includes treatment of lead-contaminated that exceed the toxicity criterion. This alternative costs more, but affords an added level of protection in the long-term by treating the excavated soils prior to offsite disposal, although short-term implementation risks will have to be controlled. Furthermore, space would need to be obtained to operate the equipment for the S/S process and increased truck traffic within the residential is likely due to the additional movement of soil to/from the treatment area.

Recommended Alternative

The recommended alternative for the residential area surrounding the Dutch Boy Site is Alternative 1. This alternative provides for excavation and proper disposal of all soils in the unpaved residential areas surrounding the site that exceed 500 mg/kg lead and meet the lead toxicity characteristic criterion. This alternative eliminates the potential for inhalation and ingestion of unacceptable levels of lead in unpaved area soils throughout the residential areas.

If any portion of the excavated soil exceeds the lead toxicity characteristic criterion, NL may elect to use Alternative 2 to stabilize soil prior to disposal to limit any future potential risks associated with the excavated soil.

In conclusion, this remedy is adequately protective of public health and the environment, meets the statutory criteria established under the NCP, is consistent with the Administrative Order, and is a cost effective remedy.

Implementation

The schedule for implementation of the Recommended Alternative is outlined below.

- Week 0 EPA approval of RMP
- Week 1 Project Mobilization
- Weeks 2 - 9 Preparation of Remedial Design and Plans
- Weeks 10 - 13 EPA Approval of Remedial Design and Plans
- Weeks 14 - 19 Access Procurement/Subcontracting
- Weeks 20 - 21 Field Mobilization
- Weeks 22 - 48 Offsite Remediation (Excavation/Offsite Disposal)
- Weeks 49 - 54 Draft Report Preparation and Submittal

Two weeks after receiving the EPA's comments on the draft report, the final report will be delivered.

It is important to note that the schedule proposed above is dependent on timely procurement of access to the properties to be remediated. ESC's experience is that the time required to contact residents and obtain agreements is highly variable. We would work closely with EPA to minimize the time required. However, this task may extend beyond Week 19 of the project, requiring a delay in the remaining tasks. Also, the schedule is dependent upon weather and other factors that may not be within the control of NL or ESC. We will work closely with EPA to expedite activities and minimize delays.

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Reference

7.5 Minute Series Topographic Quadrangle
Blue Island, Illinois, US
Photorevised 1993 Scale 1:24,000

ILLINOIS

Quadrangle Location

0 2000 4000
Scale in Feet

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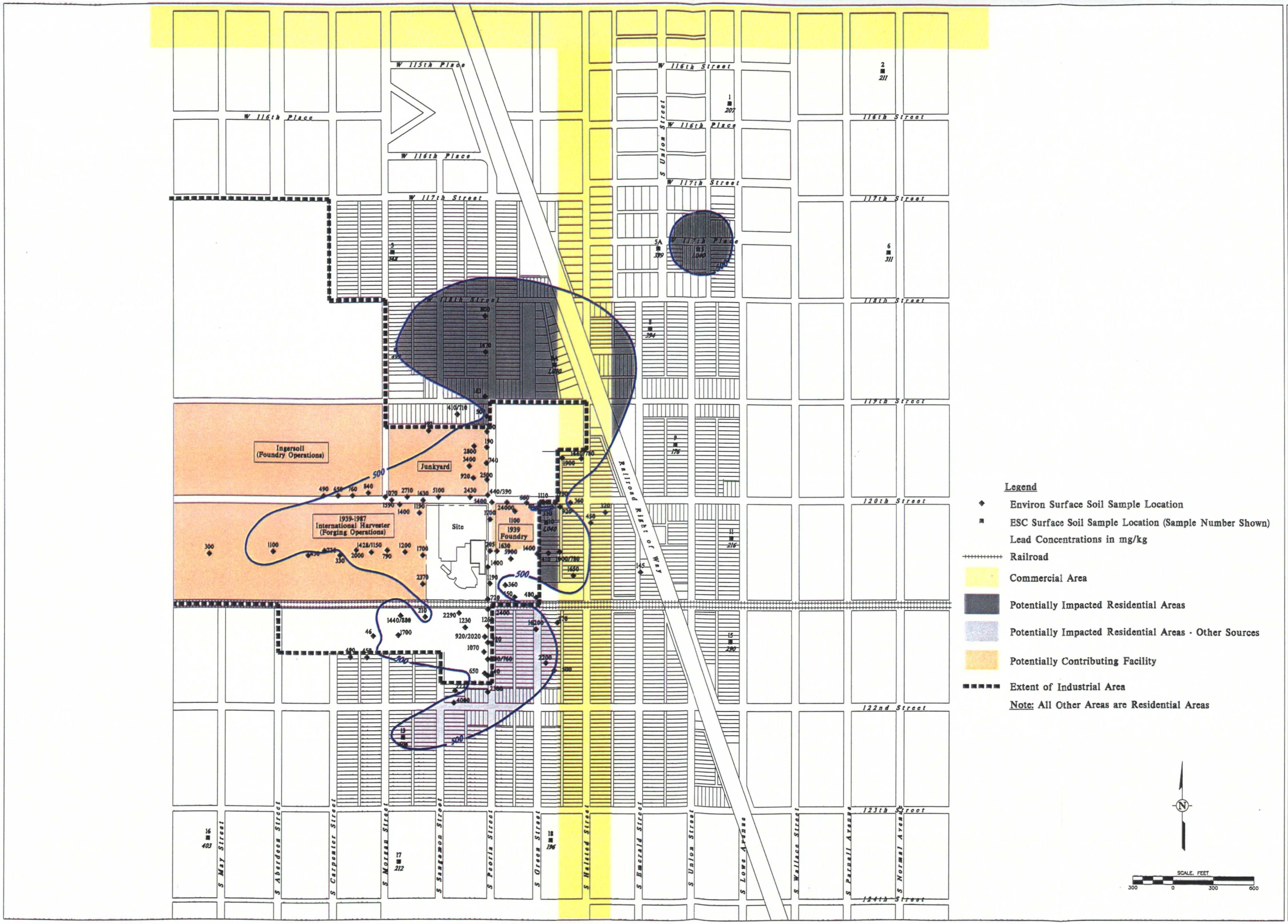
Figure 1
Site Location
NL Dutch Boy
Chicago, Illinois



REVISIONS

REV | DESCRIPTION

SEAL

DRAWN BY

CHECKED

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DATE

OFF-SITE SURFACE SAMPLE LOCATIONS

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FIGURE 2

Drawing Number
DBOY003